

Docket No. SA-537

Exhibit No. 2-A

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C.

Operations Group Chairman Factual Report

(40 Pages)



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

November 15, 2013

Group Chairman's Factual Report

OPERATIONAL FACTORS

DCA13MA120

A. ACCIDENT

Operator: Asiana Airlines
Location: San Francisco, California
Date: July 6, 2013
Time: 1128 Pacific Daylight time (PDT)¹
Airplane: Boeing B777-200 ER, HL7742

B. OPERATIONAL FACTORS GROUP

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C. SUMMARY

On July 6, 2013 at 11:28 am Pacific daylight time, a Boeing 777, registration HL7742, operated by Asiana Airlines as flight 214, struck the seawall short of runway 28L at San Francisco International Airport. The airplane was destroyed by impact forces and fire. Three of the 291

¹ All times in the report will be in Pacific Daylight Time

passengers were fatally injured. The flight was a regularly scheduled passenger flight from Incheon International Airport, Seoul, Korea, and was operated under the provisions of *14 Code of Federal Regulations Part 129*. Visual meteorological conditions prevailed at the time of the accident.

D. DETAILS OF THE INVESTIGATION

The operations/human performance group departed Washington DC on July 6, 2013 at 4:00 PM PDT on an FAA airplane and arrived in San Francisco about 00:15 AM PDT July 7, 2013. Following an organizational meeting the morning of July 7, the group went to the accident site and began to retrieve materials from the cockpit. The existence of biological specimens for one flight crew member (the relief first officer) was determined on July 7, and the hospital was asked to retain the samples, which were received by the Civil Aerospace Medical Institute on July 11. Crew interviews were conducted July 8, 9 and 11. Additional materials were retrieved from the cockpit on July 10. Cockpit documents and materials were inventoried on July 10 and unneeded materials were returned to Asiana Airlines that day. Cockpit materials were photographed and scanned on July 11 and 12 and flight crew personal electronic devices were shipped to the NTSB lab on July 11. The group chairmen received an overview briefing of part 129 and FAA oversight of Asiana Airlines from the FAA International Field Office on July 11. Contacts were made with certain witnesses to the accident.

Requests were made to Asiana and Boeing for flight documents, crew information and manuals and to FAA and Asiana for crew background documents.

The operations and human performance group reconvened in Seoul, Korea on Monday, July 29, 2013. Captain Mike Coker of Boeing, who had been a member of the group during the initial interviews in San Francisco, was replaced by Captain Linda Orlady of Boeing. Captain Lee Dae Young from KARAIB was added to the group. The group conducted 16 interviews with Asiana and MOLIT personnel, spent 3 hours in a B777 level D flight simulator, and visited Asiana's safety department. The group also collected photos from the flight simulator session and numerous documents from Asiana Airlines. The group completed its Korea activities August 6, 2013.

The operations and human performance group attended autoflight systems briefings by Boeing personnel in Seattle, Washington from August 27 to August 29, 2013. Additional telephone interviews were conducted September 12, 19, 24 and 27, 2013.

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E. FACTUAL INFORMATION

1.0 History of the Flight

According to Asiana Airlines records, the flight departed the gate at Incheon airport (ICN), Republic of Korea, at 00:30 AM PDT (4:30 PM KST²) and took off at 00:53 PDT (4:53 PM KST). There was a crew of 4 pilots and 12 flight attendants, and there were 291 passengers. The crew was based at ICN and the flight was the first flight of a scheduled two day trip, with a scheduled layover in San Francisco (SFO). The flight plan showed an estimated time enroute of 10 hours and 24 minutes.

Two of the pilots, a trainee captain and an instructor pilot (IP), were the primary flight crew, and two pilots, a second captain and FO, were relief pilots. The trainee captain occupied the left seat and was the pilot flying (PF) for the takeoff and landing. The IP, who was the pilot-in-command (PIC), was the pilot monitoring (PM) for the takeoff and landing. The relief captain and first officer (FO) occupied seats in the cabin for takeoff and during the initial part of the flight.

The flight was an operating experience (OE) training flight for the trainee captain. The relief FO stated in an interview that he and the relief captain came forward to the cockpit 4 hours and 15 minutes after takeoff and assumed flight crew duties for the next 5 hours and 15 minutes of flight, allowing the primary flight crew to rest in the cabin. The relief FO came to the cockpit again as the flight descended through 11,000 ft. MSL³ and occupied the cockpit jumpseat during the approach and landing. The relief captain remained in the cabin for the descent, approach, and landing.

The trainee captain stated in an interview he returned to the cockpit one hour and 30 minutes before the flight's estimated time of arrival (ETA). The relief captain stated that he had personally programmed the flight management computer (FMC) with the Golden Gate 6 arrival and the localizer 28L approach into SFO. According to the relief FO, he and the relief captain gave some tips to the trainee captain, including the likelihood of getting "shortcut" vectoring and the possibility of being held at high altitude for longer than normal during the approach. The trainee captain stated he obtained the automatic terminal information service (ATIS) information and conducted a thorough approach briefing. He was aware the runway 28L glide slope was out of service and he planned a visual approach to runway 28L with an approach speed of 137 kts.

During the flight's descent on the Golden Gate 6 arrival the flight was cleared by NORCAL Approach Control to depart the SFO VOR⁴ on a heading of 140°. After the flight crossed the VOR, NORCAL cleared the flight to slow to 210 kts. and maintain 9,000 ft. MSL. The trainee captain stated he used the FLCH SPD (flight level change speed) mode of the autopilot flight director system (AFDS) and the speed brake during further descent to 6000 ft. MSL. After further vectors and lower altitudes, NORCAL asked the flight if the airport was in sight.

² Korea Standard Time

³ Mean sea level

⁴ San Francisco very high frequency omni range

According to recorded information, NORCAL stated “Asiana 214 heavy, San Francisco airport 9 to 10 o’clock, one seven miles, do you have it in sight?” The flight responded they had the field in sight and NORCAL cleared them to fly a visual approach to runway 28L on an assigned heading of 310° to intercept final approach. At a point approximately 14 NM⁵ from the airport NORCAL instructed the flight to maintain 180 kts. until 5 NM from the airport.

The trainee captain stated that after arming and intercepting the localizer he set the DUYET intersection crossing altitude of 1,800 ft. MSL in the mode control panel (MCP) altitude window and began using the AFDS vertical speed (VS) mode to descend at 1000 feet per minute (FPM). The IP stated the arc on the navigation display (ND) showed they would be high at DUYET. The observer stated he thought they were a little higher than the normal profile when they were cleared for the approach, and they extended the landing gear earlier than normal because they needed to get down. The trainee captain set the command airspeed bug to 172 kts, and acknowledged when the observer commented this was below the assigned 180 kts. At the prompting of the IP, the trainee captain increased the command vertical speed to 1,500 FPM. The trainee captain commanded the flaps be set to 20° and requested the IP to reset the command altitude from 1,800 ft. to 3,000 ft., the missed approach altitude, as the flight approached 2,000 ft. MSL. The trainee captain called for the flaps to be set to 30°, and after a delay due to the airspeed being in excess of the flap limit speed of 170 kts. the IP placed the flaps to 30°.

According to recorded data, at 1,600 ft. MSL the AFDS pitch mode changed to FLCH SPD, the throttles began to increase power, and the airplane pitch attitude began to increase; this was followed by autopilot disconnect and shortly thereafter a reduction in the thrust levers to the idle position, followed by a change of the autothrottle mode from THRUST to HOLD⁶. The trainee captain stated he considered pressing the FLCH pushbutton to obtain a higher descent rate but he could not recall what he did for sure. He disconnected the autopilot and called out “manual flight.” None of the three pilots could recall the autothrottle status displayed on the flight mode annunciator (FMA). The IP stated he set the command airspeed to the approach speed of 137 kts. and turned both flight director (FD) switches off and then turned the right FD switch back on. Recorded data showed the left FD switch was turned off but the right FD switch remained on. The instructor pilot stated he saw 2 red and 2 white precision approach path indicator (PAPI) lights at 1,000 ft. MSL and speed was a little high. The observer saw the descent rate on the vertical speed indicator was in excess of 1,000 FPM as the flight descended through 1,000 ft. MSL, and he called out “sink rate” several times. The IP stated he heard this callout but they were still high and the descent rate was only 1,000 to 1,100 FPM.

The observer stated he saw 2 white and 2 red lights on the PAPI as the flight descended through 500 ft. radar altitude (RA). He noticed the throttle position was pretty far back and he could not see the runway through the windscreen or the PAPI’s after that time. The IP stated that at 500 ft. RA the airplane was slightly low, and he saw 3 red and 1 white light on the PAPI. The trainee captain stated he began to see 3 red and 1 white light on the PAPI at 500 ft. RA, and if he allowed the PAPI indication to go to 4 red lights he would fail his flight and would be embarrassed. He pitched the airplane up to avoid going low but could not recall moving the throttles. He stated at about that time “he saw some light and was in blindness for a second.” He

⁵ Nautical miles

⁶ See attachment 11 – simulator photo of FMA in HOLD

stated the blindness was only momentary and he could see the speed tape afterward. The IP stated he did not see any such light.

Recorded data showed that the airspeed decreased from 135 to 118 kts. as the airplane descended from 500 ft. RA to 200 ft. RA. The trainee captain recalled that the airplane pitch attitude was 4 to 5 degrees nose up during this time. He stated they should have maintained the airspeed manually but he believed the AT should have come out of the idle position to prevent the airplane from going below the minimum speed. The IP stated at about 200 ft. RA the airspeed was about 120 kts., he saw 4 red lights on the PAPI, and he thought perhaps the autothrottle (AT) was not working.

The trainee captain and the observer stated they did not hear any aural low speed warning. The IP did hear a low speed warning, which he described as “too low, too low.” The trainee captain stated he noticed an “airspeed low” or “autothrottle” EICAS message. At that time, the IP pushed the throttles forward and called out “go around.” He pitched up to more than 10° but the airplane continued to sink. The stick shaker activated and 2 or 3 seconds later the airplane’s aft fuselage struck the seawall.

According to the IP, the airplane ballooned, landed on the runway and yawed to the left 360°. The airplane was enveloped in dust when it came to a stop. The IP attempted to contact the tower to determine the airplane condition as seen by the tower. When the cabin manager came to the cockpit and asked if they should initiate an evacuation, he said “standby.” When the IP understood emergency vehicles were already coming, he called for an evacuation and read and accomplished the evacuation checklist. The observer stated he exited the airplane via the 1L slide, but returned to the airplane via the 2L slide to assist the cabin crew, and subsequently re-exited the airplane using the 2L slide. The IP exited via the 2L slide after checking on the progress of the cabin evacuation. The trainee captain walked back through the cabin and exited the airplane via one of the aft left slides, but he was not certain which one. The pilots and some of the flight attendants assembled on a paved road to the left side of the airplane and were transported in a shuttle bus to the terminal. The observer sustained injuries and was transported to a local hospital for examination. The trainee captain and IP received medical treatment after returning to Korea.

2.0 Flight Crew Information

Four pilots, three captains and one FO, were assigned to the flight. One captain and one FO were assigned to be cruise relief pilots.

The cruise relief captain was seated in the aircraft cabin during the descent, approach and landing at SFO. The cruise relief captain’s certification, training and flight time records were reviewed and no discrepancies were found. His flight crew information is not presented here.

A summary of other flight crew information, including a record of the crew’s flights into SFO, was provided by Asiana.⁷

⁷ See attachment 5 – crew information summary

2.1 The Trainee Captain

The captain trainee and pilot flying (PF) was 45 years of age. He occupied the aircraft left seat for the approach and landing. According to Asiana company records the captain was hired March 2, 1994. The captain stated in an interview he began his career with the airline as a cadet pilot and underwent *ab initio* flight training at a flight school in Florida. He stated he was a student pilot for Asiana from 1994 to 1996, and began first officer (FO) training on the B737 in 1996. According to Asiana records, he served as a B737 FO and a B747-400 FO before upgrading to B737 captain on December 15, 2005. He transitioned to A320 captain on October 22, 2007. Asiana records showed that the captain trainee had been an A320 ground school instructor from January 11, 2008 to June 29, 2012, and an A320 simulator instructor and operating experience (OE) instructor pilot (IP) from June 16, 2010 to November 2, 2011. He began transition training to B777 captain on March 25, 2013.

Asiana records showed the captain trainee had no absences or sick leave in the three years before the accident, and that he had no record of prior accidents, incidents, violations or company disciplinary action.

The trainee captain stated in an interview he found flying the approach to SFO very stressful. He stated it was very difficult to perform a visual approach with a heavy airplane. Beginning with the planning phase it was very stressful because the glideslope was very helpful to making an approach. He knew the NOTAMs said the glideslope was out of service, but everyone else had been doing the visual approach, so he could not say he could not do the visual approach. That had been “a very stressful factor”. Asked whether he was concerned about his ability to perform the visual approach, he said “very concerned, yea”. Asked what aspect he was most concerned about, he said, “the unstable approach”. He added, “exactly controlling the descent profile and the lateral profile, that is very stressful.”

The trainee captain was asked how confident he felt about his knowledge of the B777 autoflight system just prior to the accident. He stated he was not so confident because he felt he should study more. He did not know why the airplane got so slow on short final at 200 to 300 ft. AGL⁸. He stated he had learned that on the B777 the autothrottle system was always working. He said he believed the autothrottle should have come out of the idle position to prevent the airplane going below the minimum speed.

In a statement provided to the NTSB, two Asiana pilots, a B777 ground school instructor and a captain trainee, stated that the accident trainee captain had been in class with them in April, 2013, in which they discussed the fact that when the B777 autothrottle mode goes to HOLD that it will not automatically re-engage when in a descent using the FLCH SPD⁹ mode of the autopilot. The ground school instructor stated that he provided this training because he had personally experienced, in flight, an unexpected activation of HOLD mode and thus the failure of the autothrottle to re-engage. He stated that he wanted to warn his students on this aspect of the B777 automation.

⁸ Above ground level

⁹ See attachment 3 – statements of captains Kim and Jung

2.1.1 The Trainee Captain's Pilot Certification Record

Records from the Republic of Korea and the United States FAA showed the progressive record of certification and original issue dates of the captain trainee as follows:

Issued by the Republic of Korea Office of Civil Aviation:

Commercial Pilot – Airplane Multiengine Land – October 18, 1995
Commercial Pilot – Instrument (Aeroplane) – November 24, 1995
B737-400 type rating – April 25, 1996
B747-300 type rating – April 23, 1999
Airline Transport Pilot – Aeroplane Multiengine Land – September 5, 2001
A320 type rating – September 20, 2007
B777 type rating – June 3, 2013

According to the Republic of Korea Office of Civil Aviation the captain trainee did not have a licensing action or involvement in any serious incident or accident within the previous 3 years¹⁰.

Issued by the United States of America FAA:

Airline Transport Pilot (ATP) – July 1, 2001¹¹
 Airplane multi-engine land
 Private privileges – airplane single-engine land
Commercial Pilot – February 20, 1995
 Airplane multi-engine land
 Instrument airplane
 Private privileges airplane single-engine land
Private Pilot – November 30, 1994
 Airplane single-engine and multi-engine land
Private Pilot – August 20, 1994
 Airplane single-engine land

2.1.2 The Trainee Captain's Pilot Certificates and Ratings Held at Time of the Accident

Issued by the Republic of Korea Office of Civil Aviation:

Airline Transport Pilot License (ATPL) – June 4, 2013
 Aeroplane/Multi-Engine Land, I.F.R. (aeroplane)
 Type ratings:
 A320, B737, B747-400, B777
 Level of language proficiency:

¹⁰ See attachment 2 – Republic of Korea crew certification

¹¹ The U.S. ATP was re-issued September 16, 2009 as a result of a reported address change.

Level 4 (September 15, 2015 valid date)

According to information provided by the Republic of Korea, Office of Civil Aviation Personnel Licensing Division, the captain's most recent medical certificate was issued July 4, 2013 with no limitations and its expiration date was September 30, 2014.

Issued by the United States of America FAA:

Airline Transport Pilot (ATP) – September 16, 2008
Airplane Multiengine Land
Private privileges
Airplane Single Engine Land
English Proficient

Records from the FAA showed the trainee captain obtained an FAA medical examination on March 22, 2001. No disqualifying conditions or limitations were noted at that time. An FAA medical certificate was not required for him to operate the flight.

2.1.3 The Trainee Captain's Recent Training and Proficiency Checks Completed

Proficiency check (B777 transition simulator check) - May 18, 2013
Line check (A320) – September 7, 2012

The trainee captain began transition training on the B777 March 25, 2013 and completed ground training, simulator training, a simulator check, and operating experience (OE) ground school. He completed his B777 simulator proficiency check on May 18, 2013 and his aircraft (line oriented flight training) check on May 30, 2013.¹² Training records indicate the trainee captain performed a visual approach 6 times during the simulator stage of his transition training in 2013, receiving a grade of "good" each time. He began observation flights June 14, 2013. The observation flights were round trips to Cheju Island and Hong Kong during which he logged 9 hours and 35 minutes of observer time. He began flying the B777 with an instructor pilot on regular Asiana flights as part of his required initial OE on the airplane on June 16, 2013.¹³ The OE flights originated at and returned to Incheon Airport in Korea. The destination airports were:

1. Narita (NRT)
2. Los Angeles (LAX)
3. London (LHR)
4. Narita (NRT)
5. San Francisco (SFO)

¹² See attachment 19 – Trainee captain's simulator training record

¹³ See attachment 18 – Trainee captain's OE Training Record

The trip to San Francisco was the accident flight. Of the 20 flight legs and 60 hours of flight time he was required to complete on OE according to Korean regulations, he had completed 8 flight legs and 33 hours and 31 minutes before the accident flight.

A review of the trainee captain's OE training record showed "normal progress" as the most common comment. Takeoff technique and late rotation were commented on twice, instrument monitoring twice, flaps 30 limit speed once, FMC¹⁴ work once, use of VNAV¹⁵ once, and flare and touchdown 3 times. On a flight July 4, 2013, the instructor commented that the trainee captain had allowed the nose to drop during flare before reaching the threshold of the runway.

Three OE IP's who had flown with the trainee captain were interviewed. One IP stated he reminded the trainee captain to continually follow the path or VASI and to continually crosscheck and monitor the displays to keep up with the constant descent angle. The IP stated the trainee captain was "a little bit off glide path." He also commented that the trainee captain was about average for his stage of training and that he did not fly any visual approaches without an ILS during the OE flights they flew. He commented on one landing that the trainee captain's touchdown point and flare technique was only fair, and he needed to maintain some back pressure to keep the nose from pitching down during landing.

A second IP commented that the trainee captain did not flare soon enough, but corrected this tendency after he was advised about it. A third IP stated that he was not sure if the trainee captain was making normal progress because the trainee captain did not perform well during the trip they conducted two days before the accident. He said that the trainee captain was not well organized or prepared, that he conducted inadequate briefings, and that he deviated from multiple standard operating procedures. In addition, he reported that the trainee captain had allowed his descent path to go low at an altitude of 200 to 100 feet and his descent rate was a little high on short final. He stated the trainee captain was not carefully monitoring, examining or focusing on the operations and he accepted the IP's advice "very lightly" and was not seriously focused on operating the right way.

2.1.4 The Trainee Captain's Flight Times

The captain trainee's flight times prior to the accident flight, based on Asiana Airlines records:

Total pilot flying time	9,684 hrs.
Total Pilot-In-Command (PIC)	3,729 hrs.
Total B777 flying time	33 hrs.
Total flying time last 24 hours ¹⁶	0 hrs.
Total flying time last 7 days	5 hrs.
Total flying time last 30 days	33 hrs.
Total flying time last 90 days	57 hrs.
Total flying time last 12 months	604 hrs.

¹⁴ Flight management computer

¹⁵ Vertical navigation

¹⁶ Prior to the accident flight

A detailed breakdown of the trainee captain's flight experience showed that he logged 238 hours in flight school, 3,059 hours in the B747 as FO or trainee, and 3,581 hours in the B737, 1,052 hours of which was as PIC. He logged 2,771 hours in the A320, of which 2,298 hours was as PIC and 378 hours of which was as IP.

Asiana records show the trainee captain flew 29 trips as a B747 FO from July 24, 1997 to April 29, 2004 which transited SFO. On those 29 trips, he made 4 landings at SFO. Of the 95 flight legs he flew on those trips, he made 12 landings total. The trainee captain's most recent flight into SFO prior to the accident was on April 29, 2004. His most recent prior landing at SFO was on July 30, 2002.

The trainee captain stated in an interview that during the time he was a B747 FO he could only recall making a manual landing once at SFO. He recalled a captain allowed him to do an autoland at SFO using the ILS runway 28R approach. He stated he had never landed at SFO in any other airplane type besides the B747.

2.2 The Instructor Pilot

The IP, who was the PIC of the flight and the PM during the accident flight, was 49 years of age. He occupied the aircraft right seat during the approach and landing. He was a former Korean Air Force pilot and stated in an interview he flew the RF-4C. He was hired at Asiana February 1, 1996. He was initially qualified as a B767 FO and upgraded to captain on the B767 March 21, 2001. He transitioned to B777 captain January 16, 2008. He underwent B777 instructor pilot training in May and June, 2013 and became qualified as IP June 12, 2013. The accident flight was his first time acting as an instructor.

2.2.1 The Instructor Pilot's Pilot Certification Record

Records from the Republic of Korea and the United States FAA showed the progressive record of certification and original issue dates of the IP as follows:

Issued by the Republic of Korea Office of Civil Aviation:

Commercial Pilot – Aeroplane Multiengine Land – January 13, 1996
Commercial Pilot – Instrument (Aeroplane) – November 20, 1996
B767-300 type rating – November 20, 1996
Airline Transport Pilot – Aeroplane Multiengine Land – October 28, 1998
B777 type rating – November 19, 2007

Issued by the United States of America FAA:

Private pilot (foreign based) – July 19, 2012
Airplane multi-engine land
Limitations: All limitations and restrictions on the Republic of Korea license apply

English proficient

Issued on the basis of and valid only when accompanied by Republic of Korea pilot license

2.2.2 The Instructor Pilot's Pilot Certificates Held at the Time of the Accident

Issued by the Republic of Korea Office of Civil Aviation:

Airline Transport Pilot License (ATPL) – December 20, 2010

Aeroplane/Multi-Engine Land

I.F.R. (Aeroplane)

Type ratings:

B757/767, B777

Level of language proficiency:

Level 4 (September 15, 2015 valid date)

The IP's airman medical certificate was class 1 with no limitations and was dated September 5, 2012. According to information provided by the Office of Civil Aviation Director, Personnel Licensing Division, the IP's medical certificate expiration date was September 30, 2013.

Issued by the United States of America FAA:

Private Pilot – July 19, 2012

Records from the FAA showed the IP's most recent FAA medical examination took place on March 22, 2001. No disqualifying conditions were noted at that time.

2.2.3 The Instructor Pilot's Recent Training and Proficiency Checks Completed

Instructor Pilot aircraft check – June 12, 2013

Instructor Pilot aircraft training – June 10, 2013

Instructor Pilot right seat simulator check – June 7, 2013

Instructor Pilot simulator Training – May 24 – June 6, 2013

Instructor Pilot simulator check – panel – May 26, 2013

Instructor Pilot ground school – May 14 -21, 2013

Proficiency check – March 18, 2013

Line check – January 19, 2013

A review of the IP's instructor training records showed no significant deficiencies. Typical comments were "good performance" or "very good performance."¹⁷ Records indicate that he performed a visual approach three times during the simulator stage of his instructor pilot training in 2013, receiving a grade of "Good" on each occasion.

¹⁷ See attachment 20 – Instructor Pilot's training record

Instructors who had flown with the IP during his recent instructor training were interviewed. One instructor stated the IP had a good character and personality and he could be a very good instructor. He discussed common errors instructors see in transitioning pilots. He stated it was a common error for pilots making the transition from smaller to larger airplanes to make a late flare because of the increased height of the larger airplane. The captain who conducted the IP's recent OE final check flight stated that he was very calm, followed the procedures correctly, had professional knowledge of the flight, and had good capability and skill as an instructor.

One of the instructors who provided training to the accident IP stated the IP performed well enough in the simulator. He told new instructors that when they were in the right seat, they were chosen because of a higher level of proficiency. They had to do the FO's job and do it well, and at the same time they had to supervise the new captain in training. His advice was the IP should let the trainee do his job as much as possible but never go beyond their own comfort level.

2.2.4 The Instructor Pilot's Flight Times

The instructor pilot's flight times prior to the accident flight, based on Asiana records:

Total pilot flying time	12,307 hrs.
Total pilot in command (PIC)	9,045 hrs.
Total B777 flying time	3,208 Hrs.
Total flying time last 24 hrs.	0 hrs.
Total flying time last 7 days	0 hrs.
Total flying time last 30 days	71 hrs.
Total flying time last 90 days	211 hrs.
Total flying time last 12 months	841 hrs.

A detailed breakdown of the instructor pilot's flight experience showed that he logged 48 hours in flight school, 1,821 hours in the Korean Air Force, and 7,229 hours in the B767, 4,499 hours of which was as PIC. Prior to the accident trip, he had not logged any IP time in the B777.

Asiana records show the instructor pilot flew 33 trips as a B777 captain from December 12, 2007 to May 10, 2013 which transited SFO. On those 33 trips, he made 17 landings at SFO. His most recent prior landing at SFO was on May 8, 2013.

2.3 The Observer

The observer was 40 years of age. According to Asiana company records he was hired December 12, 2007. The observer stated in an interview he was a former Korean Air Force pilot and he flew the F5 and F16 aircraft. He was initially qualified on the A320 as an FO, and transitioned to the B777 March 3, 2012.

2.3.1 The Observer's Pilot Certification Record

Records from the Republic of Korea and the United States FAA showed the progressive record of certification and original issue dates of the observer as follows:

Issued by the Republic of Korea Office of Civil Aviation:

Commercial Pilot – Aeroplane Multiengine Land – July 28, 1997
Commercial pilot – Instrument (Aeroplane) – March 8, 1996
A320 type rating – August 22, 2008
Airline Transport Pilot License (ATPL) – June 12, 2011
B777 type rating – April 2, 2012.

According to information provided by the Office of Civil Aviation Director, Personnel Licensing Division, the observer’s medical certificate was issued July 4, 2013 with no limitations and its expiration date was July 31, 2014.

No FAA certification records were found for the observer.

2.3.2 The Observer’s Pilot Certificates and Ratings Held at Time of the Accident

Issued by the Republic of Korea Office of Civil Aviation:

Airline Transport Pilot License (ATPL) – June 12, 2011
Aeroplane/Multi-Engine Land, I.F.R. (aeroplane)
Type ratings:
A320, B777
Level of language proficiency:
Level 4 (September 15, 2015 valid date)

According to information provided by the Office of Civil Aviation Director, Personnel Licensing Division, the observer’s medical certificate was issued July 4, 2013 with no limitations and its expiration date was July 31, 2014.

2.3.3 The Observer’s Recent Training and Proficiency Checks Completed

Proficiency check – March 11, 2013
Line check – May 27, 2013

2.3.4 The Observer’s Flight Times

The observer’s flight time prior to the accident flight, based on Asiana records:

Total pilot flying time	4,557 hrs.
Total pilot in command (PIC)	1,445 hrs.
Total B777 flying time	715 hrs.
Total flying time last 24 hrs.	0 hrs.
Total flying time last 7 days	0 hrs.
Total flying time last 30 days	57 hrs.

Total flying time last 90 days	232 hrs.
Total flying time last 12 months	931 hrs.

A detailed breakdown of the observer's flight experience showed that he logged 1,497 hours in the Korean Air Force, 1,445 of which was PIC, and 2,344 hours in the A320 before transitioning to the B777.

Asiana records show the observer flew 7 trips as a B777 FO from May 29, 2012 to April 10, 2013 which transited SFO. On those 7 trips, he made no landings at SFO. Of the 14 flight legs he flew on those trips, he made 2 landings total, both of which were at Incheon. The observer's most recent flight into SFO prior to the accident was on May 10, 2013. He had never landed at SFO.

3.0 The Airport

San Francisco International Airport was located 8 NM southeast of San Francisco, California. The airport elevation was 13 ft. MSL. The airport had 4 runways. They were runway 10L/28R, 11,780 ft. in length and 200 ft. in width, runway 10R/28L, 11,381 ft. in length and 200 ft. in width, runway 1R/19L, 8,646 ft. in length and 200 ft. in width, and runway 1L/19R, 7,500 in length and 200 ft. in width. According to the 10-8A chart for SFO, the approach end of runway 28L was displaced 300 ft. at the time of the accident.

The airport had 9 standard terminal arrival routes (STAR's), ILS or LOC approaches to runways 19L, 28L and 28R, RNAV approaches to runway 10L, 10R, 19R, 28L and 28R, an LDA approach to runway 28R and two charted visual approaches to runway 28L and 28R.

According to NOTAM's in effect at the time of the accident, the glide slope was out of service for the ILS approaches to runway 28L and 28R.

The accident crew flew the Golden Gate 6 Arrival and received vectors to the ILS/LOC Z 28L approach before they were cleared for the visual approach to runway 28L.¹⁸

4.0 The Airplane

4.1 Airplane Performance

4.1.1 Weight and Balance

The following weight and balance information was taken from the Asiana load sheet for the flight. Limitations were obtained from the Boeing Flight Crew Operations Manual (FCOM), D632W001-AAR, dated June 15, 2013, page L.10.3.

Basic Operating Weight	325,008 lbs.
Passenger Weight ¹⁹	45,790 lbs.
(262 adults, 30 children, 1 infant)	

¹⁸ See attachment 6 – SFO arrival, approach and airport charts.

¹⁹ The passenger manifest showed one less person, 291 plus 1 infant, on board.

Baggage Weight (304 bags, 10,245 lbs. actual weight)	22,706 lbs.
Plus Cargo Weight	
Zero Fuel Weight	393,504 lbs.
Maximum Zero Fuel Weight	430,000 lbs.
Fuel	194,201 lbs.
Ramp Weight	587,705 lbs.
Maximum Ramp Weight	634,500 lbs.
Taxi Fuel	1,001 lbs.
Takeoff Weight	586,704 lbs.
Maximum Allowable Takeoff Weight	632,500 lbs.
Planned Trip Fuel	165,499 lbs.
Planned Landing Weight	421,205 lbs.
Maximum Landing Weight	460,000 lbs.
Takeoff Center of Gravity	28.41 % MAC

Standard passenger weights were taken from the Asiana Pilot Operating Manual (POM), revision 3, dated September 1, 2009, page 6-6. Those weights were 75 kg. (165 lbs.) for an adult, 37 kg. (82 lbs.) for a child and 10 kg. (22 lbs.) for an infant. The POM stated baggage and cargo would be actual weights. These weights for combined baggage and cargo were shown on the weight and balance form by compartment, compartments 1 through 5, and the total baggage and cargo weight shown was 22,706 lbs.

4.1.2 Approach speed

The last recorded aircraft weight on the flight data recorder prior to the accident was 423,360 lbs. According to the Boeing B777 FCOM – Performance Inflight – QRH, page PI-QRH 20.5, “Vref,” dated June 15, 2012, the appropriate Vref speed for the accident flight was 132 kts.

According to the Boeing B777 FCOM, pages 11.43.19-20, “Approach Reference Page,” dated December 15, 2012, the Flight Management Computer (FMC) calculated airplane gross weight and appropriate Vref speeds for 20°, 25°, and 30° of flaps display in that page. The pilot may press the appropriate line select key for the intended flap setting and that will cause the selected reference speed to be entered for landing. The Vref speed will display on the primary flight displays (PFD’s).

The Boeing Flight Crew Training Manual (FCTM), page 1.11, dated June 30, 2013, stated:

“Command speed is set to the maneuver speed for the selected flap position manually using the MCP.”²⁰

“When using the autothrottle, position command speed to VREF + 5 knots. Sufficient wind and gust protection is available with the autothrottle connected because the autothrottle is designed to adjust thrust rapidly when the airspeed drops below command speed while reducing thrust slowly when the airspeed exceeds command speed. In turbulence, the result is that average thrust is higher

²⁰ Mode control panel

than necessary to maintain command speed. This results in an average speed exceeding command speed.”

According to flight data recorder information, the MCP command speed was set to 137 kts. on final approach and remained there until the end of the flight.

4.1.3 Flap Limit Speeds

According to the Boeing FCOM, page 9.10.9, dated December 15, 2012, the flap limit speeds as denoted on the flap limit placard on the center forward panel were:

- 1 – 255 kts.
- 5 – 235 kts.
- 15 – 215 kts.
- 20 – 195 kts.
- 25 – 185 kts.
- 30 – 170 kts.

4.2 B777 Airplane Systems

The following systems information was derived from the Boeing B777-28E FCOM for Asiana Airlines. Asiana Airlines listed this manual as one of the approved manuals for the use of their flight crews.

4.2.1 Automatic Flight

The automatic flight control system consisted of the autopilot flight director system (AFDS) and the autothrottle system (A/T). The MCP and the flight management computer (FMC) controlled the AFDS and the autothrottle system to perform climb, cruise, descent, and approach. The AFDS consisted of three autopilot flight director computers (AFDC's) and the MCP. The AFDS did not have direct control of the flight control surfaces. The autopilot controlled the elevators, ailerons, flaperons, and spoilers through the fly-by-wire flight control system. AFDS status was displayed just above the PFD attitude display. “FLT DIR” displayed when the flight director was ON and autopilots were not engaged, and “A/P” was displayed when autopilots were engaged.²¹

4.2.1.1 Autopilot Engagement and Disengagement

According to the FCOM, page 4.20.2, dated December 15, 2012, the autopilot was engaged by pushing either of the two MCP autopilot engage switches. The autopilot could be disengaged by pressing either control wheel autopilot disengage switches, the MCP autopilot disengage bar, or

²¹ Examples of the mode control panel (MCP), primary flight display (PFD), flight mode annunciator (FMA), and navigation display (ND) taken from the FCOM are shown in attachment 7 to this report.

by overriding the control column, control wheel, or rudder pedals. The EICAS warning message AUTOPILOT DISC displayed if the autopilot was manually or automatically disengaged.

According to the FCOM, page 4.10.18, dated June 13, 2011, the first push of the control wheel disengage switch:

- Disengaged all autopilots
- Illuminated Master Warning lights
- Displayed the EICAS warning message AUTOPILOT DISC
- Sounded an aural warning
- If the autopilot automatically disengaged, reset the Master Warning lights, EICAS warning message, and the aural warning

The second push of the control wheel disengage switch reset:

- Master Warning lights
- EICAS warning message
- Aural warning

4.2.1.2 Flight Director Engagement

Left and right flight director (FD) switches on the MCP activated the flight director steering indications of their respective PFD's. The flight director steering indications normally displayed any time the related flight director switch was ON.

4.2.1.3 Autothrottle Engagement and Disengagement

According to the FCOM, page 4.10.4, dated June 15, 2013, there were two autothrottle arm switches on the MCP. The left autothrottle arm switch controlled the left engine autothrottle and the right autothrottle arm switch controlled the right engine autothrottle. When a switch was in the ARM position it:

- Armed the selected autothrottle for mode activation
- Activated the autothrottle when VNAV, FLCH or TOGA switch was pushed
- Activated autothrottle when an autothrottle switch was pushed and the pitch mode was ALT, V/S, or G/S.

When a switch was in the OFF position it:

- Disconnected the selected autothrottle
- Prevented selected autothrottle activation

According to the FCOM, page 4.10.20, dated June 15, 2013, autothrottle disconnect switches were located on the throttles. When either switch was pushed the first time, it:

- Disconnected autothrottle (both left and right)
- Illuminated Master Caution lights
- Displayed EICAS message AUTOTHROTTLE DISC
- If autothrottle automatically disconnected, reset Master Caution lights and EICAS message.

A second push of either switch reset Master Caution lights and EICAS message. The autothrottle remained armed.

4.2.1.4 Mode Control Panel (MCP)

The MCP provided control of the autopilot, flight director, altitude alert, and autothrottle systems. The MCP was used to select and activate AFDS modes, and establish altitudes, speeds and climb or descent profiles. MCP switches selected automatic flight control and flight director modes. A light in the lower half of the switch illuminated when the switch was selected. Mode engagement was verified on the FMA.

Most modes activated with a single push. These modes included:

- flight level change (FLCH SPD)
- heading hold (HDG HOLD)
- track hold (TRK HOLD)
- heading select (HDG SEL)
- track select (TRK SEL)
- vertical speed (V/S)
- flight path angle (FPA)
- altitude hold (ALT)

Other modes armed or activated with a single push. These modes were:

- lateral navigation (LNAV)
- vertical navigation (VNAV)
- localizer (LOC)
- approach (APP)

Desired target values could be selected on the MCP for:

- airspeed
- Mach
- heading
- track
- vertical speed
- flight path angle
- altitude

4.2.1.5 Flight Mode Annunciations (FMA)

The flight mode annunciations displayed just above the PFD AFDS status annunciations. The mode annunciations, from left to right, were:

- autothrottle
- roll
- pitch

Active or captured modes displayed at the top of the flight mode annunciation boxes in large green letters. Armed modes (except for TO/GA in the air) displayed in smaller white letters at the bottom of the flight mode annunciation boxes. Degradations of a specific mode while the autopilot was engaged annunciated by an amber line through the mode annunciations. A green box displayed around the mode annunciation for 10 seconds when a mode first became active, and when the amber line through a degraded mode was removed.

4.2.1.5.1 Autothrottle Annunciations

Autothrottle annunciations were:

- THR – autothrottle applied thrust to maintain the climb/descent rate required by the pitch mode
- THR REF – thrust set to the reference thrust limit displayed on EICAS
- IDLE – displayed while the autothrottle moved thrust levers to idle; IDLE mode was followed by HOLD mode
- HOLD – thrust lever autothrottle servos were inhibited. The pilot could set thrust levers manually.
- SPD – autothrottle maintained command speed. Speed could be set using the MCP IAS/MACH selector or by the FMC, as displayed on the CDU CLIMB, CRUISE, or DESCENT page. The autothrottle would not exceed the operating speed limits or the thrust limits displayed on the EICAS. If only one thrust lever was active, "L-" or "R-" displayed in front of SPD for the active thrust lever.

4.2.1.5.2 Roll Annunciations:

Roll annunciations were:

LNAV –

- LNAV (armed) – LNAV was armed to activate when parameters were met.
- LNAV (active) – LNAV activated when above 50 feet and in position to turn onto the active route leg. In flight, selection caused immediate activation if within 2 1/2 nm of the active leg.

HDG –

- HDG SEL (active) – airplane turned to or maintained the heading set in the MCP heading/track window.
- HDG HOLD (active) – AFDS held present heading. When turning, AFDS held the heading reached after rolling wings level.

TRK –

- TRK SEL (active) – airplane turned to or maintained the track set in the MCP heading/track window.
- TRK HOLD (active) – AFDS held present track. When turning, AFDS held the track reached after rolling wings level.

ATT – (active) – when the autopilot was first engaged or the flight director was first turned on in flight, AFDS held a bank angle between 5 and 30 degrees and would not roll to wings level. When the bank angle was less than 5 degrees, AFDS rolled to wings level (HDG HOLD or TRK HOLD). When the bank angle was greater than 30 degrees, AFDS rolled to 30 degrees of bank.

LOC –

- LOC (armed) – AFDS captured localizer when within range and within 120 degrees of localizer course.
- LOC (active) – AFDS followed the localizer course.

TO/GA –

- On the ground, TO/GA annunciated by positioning either flight director switch ON when both flight directors were OFF; or, by pushing either TO/GA switch with airspeed greater than 80 KTS. TO/GA roll guidance became active at lift-off.
- In flight, TO/GA was armed when flaps were out of up or glideslope was captured. There was no flight mode annunciation for TO/GA armed. TO/GA was activated in flight by pushing a TO/GA switch. The roll steering indication provided guidance to maintain the ground track present at mode engagement.

ROLLOUT –

- ROLLOUT (armed) – displayed below 1500 feet radio altitude and activated below 2 feet.
- ROLLOUT (active) – after touchdown, AFDS used rudder and nosewheel steering to steer the airplane on the localizer centerline.

4.2.1.5.3 Pitch Annunciations

Pitch annunciations were:

TO/GA –

On the ground, TO/GA annunciated by positioning either flight director switch ON when both flight directors were OFF; or, by pushing either TO/GA switch with airspeed greater than 80 knots. The flight director PFD pitch bar indicated an initial pitch of eight degrees up. TO/GA pitch guidance became active at lift-off.

After lift-off, the AFDS commanded a pitch attitude to maintain:

- a target speed of V2 plus 15 knots or the airspeed at rotation (pitch attitude greater than two degrees) plus 15 knots, whichever was greater
- if current airspeed exceeded the target speed for 5 seconds, the target speed was reset to the lesser of the current airspeed or V2 plus 25 knots

- the IAS/MACH window speed when the window speed was changed to a speed greater than the target speed

In flight, TO/GA was armed when flaps were out of up or glideslope was captured. When a go-around was initiated, the command speed was the MCP IAS/MACH window or current airspeed, whichever was higher, to a maximum of the IAS/MACH window speed plus 25 knots. GA displayed as the thrust limit on the primary EICAS engine display.

VNAV –

VNAV was armed by pushing the VNAV switch (the light illuminates and VNAV was annunciated on the PFD pitch mode annunciation in white characters below the current pitch mode). VNAV activated at 400 feet and provided pitch commands to maintain the FMC computed airspeed/path:

- VNAV SPD (active) – AFDS maintained the FMC speed displayed on the PFD and/or the CDU CLIMB or DESCENT pages. If speed intervention was selected, the MCP IAS/MACH selector was used to manually select the speed.
- VNAV PTH (active) – AFDS maintained FMC altitude or descent path with pitch commands. If the MCP altitude window remained set to the current cruise altitude and the airplane was within two minutes of the top of descent, the CDU scratchpad message RESET MCP ALT displayed.
- VNAV ALT (active) – when a conflict occurred between the VNAV profile and the MCP altitude, the airplane leveled and the pitch flight mode annunciation became VNAV ALT. The airplane maintained altitude. The climb or descent was continued by changing the MCP altitude and pushing the altitude selector or changing the pitch mode.
- If an early descent was desired, FLCH, V/S, or FPA could be selected to descend below the VNAV descent path. If, during the decent, VNAV was armed and the airplane descent path subsequently intercepted the VNAV descent path, VNAV activated in VNAV PTH.

V/S (active) – pushing the MCP VS/FPA switch opened the vertical speed window to display the current vertical speed. Pitch commands maintained the rate of climb or descent set in the VS/FPA window.

FPA (active) – pushing the MCP VS/FPA switch opened the flight path angle window to display the current flight path angle. Pitch commands maintained the flight path angle set in the VS/FPA window.

FLCH SPD (active) – pushing the MCP FLCH switch opened IAS/MACH window (if blanked). Pitch commands maintained IAS/MACH window airspeed or Mach.

ALT (active) – altitude hold mode was activated by:

- pushing the MCP altitude HOLD switch, or

- capturing the selected altitude from a V/S, FPA, or FLCH climb or descent.

G/S (active) – AFDS followed the ILS glideslope.

FLARE (armed) – during autoland, FLARE displayed below 1500 feet RA.

FLARE (active) – during autoland, flare activated between 60 and 40 feet RA.

FLARE deactivated at touchdown and smoothly lowered the nosewheel to the runway.

4.2.2 Flight Instruments

The flight instruments and displays supplied information to the flight crew on six flat panel liquid crystal display units:

- Captain and First Officer primary flight display (PFD)
- Captain and First Officer navigation display (ND)
- the engine indication and crew alerting system (EICAS)
- the multifunction display (MFD).

4.2.2.1 Primary Flight Display (PFD)

The PFDs presented a dynamic color display of all the parameters necessary for flight path control. The PFDs provided the following information:

- flight mode annunciation
- airspeed
- ground speed
- altitude
- vertical speed
- attitude
- steering information
- radio altitude
- instrument landing system display
- approach minimums
- heading/track indications
- engine fail, GPWS, and PWS Alerts

4.2.2.2 Navigation Display (ND)

The NDs provided a mode-selectable color flight progress display. The modes were:

- MAP

- VOR
- APP (approach)
- PLN (plan)

The MAP mode was recommended for most phases of flight. Presented track up, this mode showed airplane position relative to the route of flight against a moving map background. Displayed information could include:

- selected and current track
- selected and current heading
- position trend vector
- range to selected altitude
- map range scale
- ground speed
- true airspeed
- wind direction and speed
- next waypoint distance
- waypoint estimated time of arrival
- selected navigation data points

4.2.2.3 VNAV Path Pointer

A VNAV path pointer and deviation scale was displayed on the ND when in MAP mode and displayed vertical deviation from a selected VNAV PATH during descent. The scale indicated deviation within +/- 400 ft. and a digital display was provided for deviations greater than 400 ft.

4.2.3 Warning Systems

4.2.3.1 Stall Warning and Low Airspeed Alert

The EICAS caution message AIRSPEED LOW was displayed and the box around the current airspeed indication on the PFD was highlighted amber if airspeed was below minimum maneuvering speed. An aural beeper sounded when the EICAS caution was displayed.

Warning of an impending stall was provided by left and right stick shakers, which independently vibrated the left and right control columns.

4.2.4 Pitch Trim

The flight control system used conventional control wheel, column and pedal inputs from the pilot to electronically command the flight control surfaces. The system provided conventional control feel and pitch responses to speed and trim changes. Control wheel pitch trim switches were provided.

The FCOM, page 9.20.11, “Pitch Envelope Protection - Stall Protection,” dated December 15, 2012, stated:

“Stall protection reduces the likelihood of inadvertently exceeding the stall angle of attack by providing enhanced crew awareness of the approach to a stall or to a stalled condition.

Stall protection limits the speed to which the airplane can be trimmed. At approximately the minimum maneuvering speed, stall protection limits the trim reference speed so that trim is inhibited in the nose up direction. The pilot must apply continuous aft column force to maintain airspeed below the minimum maneuvering speed. Use of the alternate pitch trim levers does not reduce the column forces. When flying near stall speed, the column force increases to a higher level than would occur for an equivalent out-of-trim condition above the minimum maneuvering speed.”

4.3 B777 Airplane Procedures

4.3.1 Autothrottle System

The Boeing FCOM, pages 4.20.8 and 4.20.9, dated June 30, 2013, stated the following:

“The autothrottle system provides thrust control from takeoff through landing.

Autothrottle operation is controlled from the MCP and the CDUs. The MCP provides mode and speed selection. The CDU allows FMC reference thrust limit selection. When a pitch mode is active, the FMC selects the autothrottle modes and target thrust values. Refer to Chapter 11, Flight Management, Navigation, for FMS and CDU operation.

The autothrottle can be operated without using the flight director or the autopilot. In this condition, the autothrottle operates in either the THR REF, SPD, HOLD or IDLE modes.

When the autothrottle is used during a manual landing, thrust reduces to IDLE at 25 feet radio altitude when the flight director is off or the pitch mode is V/S, FPA, G/S, or any VNAV mode (VNAV SPD, VNAV PTH, or VNAV ALT). The autothrottle does not automatically retard if the pitch mode is TO/GA.

With the autothrottle armed, the autothrottle automatically activates if no autopilot or F/D is active or an autopilot or F/D is in VNAV XXX, ALT, V/S, or G/S, and:

- speed less than an FMC calculated value for one second*
- thrust below reference thrust*
- airplane altitude above 100 feet RA on approach, or airplane barometric altitude 400 feet above airport on takeoff*

The autothrottle can support stall protection when armed and not activated. If speed decreases to near stick shaker activation, the autothrottle automatically activates in the appropriate mode (SPD or THR REF) and advances thrust to maintain minimum maneuvering speed (approximately the top of the amber band)

or the speed set in the mode control speed window, whichever is greater. The EICAS message AIRSPEED LOW displays.

Note: When the pitch mode is FLCH or TOGA, or the airplane is below 400 feet above the airport on takeoff, or below 100 feet radio altitude on approach, the autothrottle will not automatically activate.

Refer to Chapter 10, Flight Instruments, Displays, for PFD Indications.

Note: During a descent in VNAV SPD, the autothrottle may activate in HOLD mode and will not support stall protection.

The EICAS advisory message AUTOTHROTTLE L or R displays when the respective autothrottle servo fails. If the autothrottle is active and only one autothrottle is armed, the PFD autothrottle flight mode annunciation displays L or R preceding the mode. For example, L SPD indicates only the left autothrottle is active in speed mode.”

5.0 Company Overview

Asiana Airlines, Inc. was a major Korean domestic and international airline based in Seoul, Korea. According to company information, Asiana was established on February 17, 1988 and had a fleet of 81 airplanes providing passenger service to 23 countries and cargo service to 14 countries as of the time of the accident. As of July, 2013 Asiana’s fleet was composed of 10 Airbus A320, 24 A321 and 13 A330 and 14 Boeing B747, 8 B767, and 12 B777 aircraft. According to information provided by Asiana, the company employed 1,349 pilots, including 136 B777 captains and 129 B777 FO’s.

5.1 Flight Operations Management

Supervision of Asiana flight operations was the responsibility of the Executive Vice President of Flight Operations. Flight crew quality assurance, which managed the line operations safety audit (LOSA) program, reported directly to that executive. Reporting to the Executive Vice President were two senior vice presidents, the Senior Vice President for Flight Planning and the Senior Vice President for Flight Crew Operations. Many of the work functions of the departments were organized into teams, which were described in the Asiana Flight Operations Manual (FOM).²²

Guidance to the accident pilots was found in numerous documents provided and approved by Asiana, including the FOM, the Boeing FCOM, the B777 Pilot Operations Manual (POM), the Boeing flight crew training manual (FCTM), and Asiana’s flight crew training regulations (FCTR). Excerpts from these documents of interest to the investigation are presented here.

²² See attachment 4 – Asiana flight operations organization

5.2 Flight Operations Manual (FOM)

The Asiana FOM established policies, procedures, practices and instructions and guidance for the company to conduct commercial air transportation operations and assisted flight operations personnel to perform their duties. According to the introduction to the FOM, the manual was established under Aviation law Article 116.

5.2.1 Organization Structure

The Asiana FOM, paragraph 1.3, “Organizations,” described the flight operations team structure. These teams were:

- Safety & Security Management (Director)
 - Safety Management Team
 - Aviation Security Team
- Operation Control (Director)
 - Safety & Operation Control Support
 - Operation Control Center
 - Flight Planning Team
- Flight Crew Quality Assurance Team
- Flight Operations Planning Department (Director)
 - Flight Crew Support Team
 - Flight Operations Engineering Team
 - Flight Crew Training Team
 - Flight Crew Evaluation Team
- Flight Crew Operations (Director)
 - Flight Crew Schedule Team
 - B747 Flight Crew Operations Team
 - B777 Flight Crew Operations Team
 - B767 & A330 Flight Crew Operations Team
 - B737 & A320 Flight Crew Operations Team

5.2.2 FOQA Program

The Asiana FOM, paragraph 11.2.6, “FOQA Program,” dated May 1, 2006, stated:

- “a. The purpose of FOQA (Flight Operation Quality Assurance) program is to analyze flight incident and risk factor by using flight information and to use the analysis result as references for flight crew, operation procedure and program, maintenance actions.*
- b. According to Regulation, Aviation Act 143, flight information will be protected by company and it cannot be used as a punishment source. But flight crew’s intentional crime or violations will be an exception.”*

5.2.3 Penalty Free Report System

The Asiana FOM, paragraph 17.3, “Penalty Free Report System,” dated May 1, 2006, stated:

“17.3.1 General

- a. Penalty free report system is the system exempting any punishment from company when accident or similar accident was prevented by spontaneously reporting any unsafe factor that the employee experienced or seen.*
- b. Safety personnel should keep reporter’s information confidential and must use the contents of report for the purpose of preventing accident only.*
- c. Flight crew shall make and report by using Captain Report Penalty Free in CreWorld.²³*

17.3.2 Reporting Items

Penalty Free Reporting is same as follows.

- a. Unsafe cases and violations happening during flight or duties*
- b. Confidential human factor relating aircraft operations: wrong judgments or mistakes on operation by misunderstanding or confusing*
- c. Experience or mistakes relating accident.”*

5.2.4 Special Airports

The Asiana FOM, paragraph 5.5.5.2, “Special Airport,” dated May 1, 2006, defined special airports as airports designated by the Authority²⁴ where special attention was required during takeoff and landing. These included airports “interrupted by mountains, hindrances or other restrictions,” airports with special departure or arrival procedures, airports with insufficient facilities or limited information, and airports requiring special attention during takeoff and landing.

Initial and recurrent qualification for captains was explained in the following subparagraphs:

“c. Initial Qualification

Captain who is to fly into a special airport must have the following requirement within the preceding 12 calendar months.

- 1) Flight to the airport as captain trainee or captain accompanied by qualified captain or as check airmen or observer, as well as takeoff and landing at the airport. or*
- 2) A training using Pictorial Means/AV System, approved by the chief of Authority for the airport shall be completed*

Note)

- 1. Captain (PIC) who wants to fly into a special airport must acquire qualification of the airport. This qualification can replace the route qualification of general airports of the region.*
- 2. Captain (PIC) who wants to fly into a special airport must acquire the qualification of the airport, even if he (or she) has the route qualification of the region.*

²³ CreWorld is the Asiana online employee website.

²⁴ Term used to refer to the regulatory authorities of Korea.

d. The flight operation conditions for the pilots who are not certified

1) The ceiling should be higher than MEA, MOCA or initial approach altitude of the specific airport by 1000ft and visibility should be at or above 3 miles for takeoff or landing.

Note)

1. In case of diversion, and there is no general airport nearby, diversion into special airport can be allowed, even though the captain is not qualified for that airport.

2. When planning the operation with 2 Set, special airport can be selected as an alternative airport, if the captain has the qualification for the special airport,

e. Recurrent and Re-Qualification

An airport qualification shall be maintained or regained through experience on at least one takeoff and landing at the special airport or route as pilot or observer pilot within the preceding 12 calendar months or studying Pictorial Means/AV System, approved by the aviation authority for the airport.”

SFO was listed as a special airport with the notation that it had a specific procedure for departure and arrival and mountainous terrain near the airport. Asiana provided a special airport training program for crew study.²⁵

5.3 B777 Pilot Operations Manual (POM) Procedures

Asiana provided pilot guidance on B777 operations in the POM. The following topics were discussed in the POM.

5.3.1 AFCS Procedures

The Asiana B777 Pilot Operations Manual (POM), paragraph 2.1.6, “AFCS Procedures,” dated March 27, 2008 addressed general guidance to B777 pilots on the proper use of the automatic flight control system. It stated, in part:

“2.1.6.1 General

a. The crew must always monitor:

1) Airplane course

2) Vertical path

3) Speed

b. When selecting a value on the MCP, verify that the respective value changes on the flight instruments, as applicable.

c. The crew must verify manually selected or automatic AFDS changes.

d. Use the FMA to verify mode changes for the:

1) Autopilot

2) Flight director

3) Autothrottle

²⁵ See attachment 9 – Asiana special airport training slides

e. During LNAV and VNAV operations, verify all changes to the airplane's:

- 1) Course*
- 2) Vertical path*
- 3) Thrust*
- 4) Speed*

f. Call out loudly and clearly to the changes on the FMA and thrust mode display when they occur are a good CRM practice.

2.1.6.2 AFCS guideline

a. Automatic Flight Control System consists of AFDS and Auto Throttle System.

b. Auto Pilot and Auto Throttle must be controlled in order to accomplish Climb, Cruise, Descend and Approach by using MCP and CDU.

c. Operations by A/P and A/T have preference to improve safety, to reduce workload and to enhance operational capability. When a non-normal situation occurs or operating within terminal areas where air traffic congestion could be expected, the PF and the PM make full use of A/P and A/T.

d. Auto Landing is recommended for long distance flight (including night flying). However, Manual Landing can be performed by PF's decision.

e. Flight crew shall use the A/P and the A/T together. For B777, Autothrottle use is recommended during all phase of flight. Even though in manual flight, autothrottle using is also recommended.

f. The PF must compare the performance of the auto flight systems with the flight path of the aircraft. If any auto flight system is not operating as expected, change the automation level or disengage that function.

g. The PF will normally engaging the autopilot with Call out, and the PM also shall engage the auto pilot by the order PF.

Note) PF must put hands on control wheel and thrust lever in preparation of conducting manual flight after passing final approach fix in auto flight control system mode.

2.1.6.3 Time for Automation Guidelines A/P and A/T

a. When using the Autopilot and Autothrottle, pilots must adhere to the minimum autopilot engagement and disengagement altitude as stated in the FCOM VOL 1 Limitations.

b. For the purpose of improvement of manual flight skill, Instructors and Checker can control the time of auto pilot engagement, but it is usually recommended to engage auto pilot at no more than

5,000FT considering traffic in departure phase, restriction altitude and weather etc.”

5.3.1.1 Statements made about the use of automation

The Asiana B777 Chief Pilot stated in an interview the airline recommended using as much automation as possible. He agreed with the statement that Asiana pilots got most of their manual flying practice during approaches below 1,000 ft. AGL. The airline recommended turning the autopilot off at 1,000 ft. AGL when making visual approaches. He stated Asiana had no requirement to avoid using flight level change (FLCH) during an approach, but it was not recommended.²⁶ He stated when flying a manually flown visual approach it was mandatory to have the autothrottles on for final approach.

5.3.1.2 Statements made about visual approaches

An IP who flew with the trainee captain stated that OE trainees were not required to fly a visual approach. He stated he personally felt confident making a visual approach with no glideslope and just a PAPI or VASI. An IP who flew with the accident IP stated he was very confident in his own ability to fly a visual approach in the B777 without glideslope or glide path and only PAPI. He thought every pilot could perform that landing without any problems. An FO who was hired by Asiana in 2009 stated captains almost always gave him an ILS approach and he had not yet had a chance to fly a visual approach. He had seen a captain fly a visual approach with the AP off less than five times in three years.

A simulator instructor stated pilots were required to fly visual approaches in the simulator without glideslope guidance, but he thought pilots lacked confidence about visual approaches and avoided flying visual approaches because of a concern they would do something wrong.

Another instructor stated the Asiana pilots he observed had performed the visual approach profile quite well during simulator training. He stated they had been doing the setup for the visual approach using the FMS to set up the runway as long as he had been at Asiana. Their policy in the past had been to select ILS on the runway, and if you had a visual approach, you would extend the runway in the FMS and you had your visual slope to the runway. They taught a timing procedure to be used to construct visual traffic patterns. It was to be abeam the threshold of the runway at flaps 5, about 1,500 feet, and after 30 seconds select gear down, flaps 20, speed brake, and set speed. After 45 seconds they disconnected the autopilot and turned back toward the runway. If there was a glide path, they would monitor it, and if there was a visual slope, they monitored that. It was most important to look out the window at the PAPI. They used all of these things to make sure they didn't go low or high.

The Asiana B777 Chief Pilot stated that Asiana pilots were expected to be able to fly a visual approach with no flight path cues, such as a glideslope or vertical path indicator. Asked what he did to ensure that all pilots were able to do that, the Chief Pilot said every pilot was very experienced by the time they were permitted to start flying the B777, as they were required to

²⁶ POM paragraph 2.15.2.e permitted use of FLCH during a localizer approach.

have a minimum of five years of experience on the B737 or A320. He also stated that Asiana B777 pilots were well trained on visual approaches from their domestic flying, that they practiced visual approaches during B777 transition training, and that they had a simulation training and evaluation every year that included a visual approach.

A former B777 foreign²⁷ captain at Asiana stated he found it extremely difficult to get an FO to fly a visual approach or even to fly a leg. He would ask them to fly and they would say it was his decision. He would normally give them the outbound leg, which meant flying to Europe or America, but they were reluctant to fly the leg unless ordered to do so. FO's would politely decline to fly but he would say, no, you need the experience. They were reluctant to land if an airport did not have an ILS. He stated visual approaches were part of simulator training, and the training satisfied a requirement but everybody knew the profile (airport, profile, weather) and could almost do it by mechanically memorizing it. Asked to what he would attribute the reluctance to fly visual approaches, he stated they only did one visual on a check and then they went back to automation. The training was to fill in the square on the simulator check ride rather than to learn something. If they could do a complete autoflight / autoland system approach they would. He stated the FO's seemed to be well versed in autoflight systems.

Another former B777 foreign captain at Asiana stated that pilots were seldom allowed to practice visual or contact approaches and every time he offered an FO such an approach, they would refuse or be highly resistant to the suggestion because they did not feel comfortable with it and did not have experience doing it in a B777 or other big airplane. He thought they did not feel confident and did not want to make any mistakes. He stated almost all the time crews preferred to fly a coupled ILS down to 1,000 feet above the ground. He stated all the Asiana pilots he flew with were extremely competent at executing the training they were provided, but there was minimal training in how to do a visual approach. He felt that they didn't have the opportunity to practice the basic stick and rudder skills. He stated captains took more of the landings and the FO's would often have to go to the simulator to maintain landing currency. That was the case on the B777 where there were two crews on flights and there were not enough landings to go around. Crews did not get enough experience with visual flying and manual manipulation of the controls

5.3.1.3 Asiana landing statistical data

A review of all Asiana landing statistics for the year 2012 showed that on the B777 77.7% of the landings were made manually and 17.1% were auto landings. Statistics also showed that 36% of all landings made in 2012 in the B777 were made by the FO.²⁸

5.3.2 Thrust, Roll and Pitch Change of PFD

²⁷ Asiana employed some non-Korean captains

²⁸ See attachment 10 - Asiana Landing Statistical Data

The Asiana B777 Pilot Operations Manual (POM), paragraph 2.23.2.16, “Thrust, Roll and Pitch Mode Change on PFD,” dated March 27, 2008, addressed the appropriate callouts for mode changes. The following callouts, including “HOLD, VNAV Path” by the PM were shown:

PF	PM
“Checked”	← “Thrust Ref”
“Checked”	← “VNAV Speed”
“Checked”	← “Speed altitude”
“Checked”	← “Hold, VNAV Path”

5.3.3 Stabilized Approach

The Asiana B777 Pilot Operations Manual (POM), paragraph 2.13.6, “Stabilized Approach,” dated March 27, 2008, addressed stabilized approach procedures and criteria. It stated “every flight crew member must confirm and monitor a stabilized approach. In addition, the flight crew members shall plan ahead and coordinate with ATC to avoid any abrupt maneuver on an approach. If a stabilized approach is not established, go-around.” It stated countermeasures for unstabilized approaches were to anticipate, detect, correct and decide, and it stated “do not attempt to land from an unstable approach.” In a note, it stated “deciding to make a go-around does not mean that the procedure has been done wrong, but it means that crews follow the company safety policy and executed safety procedure normally.”

Stabilized approach criteria were stated in paragraph 2.13.6.5. It stated;

“a. All approaches should be stabilized by 1,000 ft. above airport elevation in IMC and 500 ft. above airport elevation in VMC. An approach is considered stabilized when all of the following criteria are met:

- 1) the airplane is on the correct flight path*
- 2) only small changes in heading and pitch are required to maintain the correct flight path*
- 3) Speed: Max Target speed +10 knots, Min Target speed - 5knots
(Target speed = Vref+Wind Correction)*
- 4) the airplane is in the correct landing configuration*
- 5) sink rate is no greater than 1,000 fpm; if an approach requires a sink rate greater than 1,000 fpm, a special briefing should be conducted*
- 6) thrust setting is appropriate for the airplane configuration*
- 7) all briefings and checklists have been conducted.*

b. Specific types of approaches are stabilized if they also fulfill the following:

- 1) ILS approaches should be flown within one dot of the glide slope and 1/2 dot of localizer (at or below 1,000 ft. AFE), or within the 1/2 dot of glide slope and expanded localizer deviation scale 1/3 dot (at or below 500 ft. AFE).*

2) during a circling approach, wings should be level on final when the airplane reaches 300 feet AFE.

c. Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.

Note)

1. An approach that becomes unstabilized below 1,000 feet AFE in IMC or below 500 feet AFE in VMC requires an immediate go around. The "VMC" above means that any of required visual references is in sight.

2. There will be delayed final flap setting during perform a certain approach such as emergency/non-normal procedure, circling approach, visual traffic pattern. In these cases checklist must be completed before final flaps.

d. At 100 feet HAT for all visual approaches, the airplane should be positioned so the flight deck is within, and tracking to remain within, the lateral confines of the runway edges extended.

e. As the airplane crosses the runway threshold it should be:

1) Stabilized on target airspeed to Max Target speed +10 knots, Min Target speed - 5knots until arresting descent rate at flare

2) On a stabilized flight path using normal maneuvering

3) Positioned to make a normal landing in the touchdown zone (the first 3,000 feet or first third of the runway, whichever is less).

Note)

1. It is acceptable to overshoot instantly in the event of turbulence, wind shear, gust wind or the sudden change of wind direction. However, the frequent occurrence of such overshooting is not proper and should not be allowed.

2. If PF decides to correct temporary deviations safely and recognizes present flying stage, he/she continue approaching in the event that GPWS alert " SINK RATE " was announced temporarily below 1,000FT and VMC (Visual Meteorological Conditions)."

The trainee captain stated in an interview that at 500 feet the airplane should be stabilized, and for a visual approach the airplane should be stabilized by 300 feet. For an unstable condition, he said they should do a go around.

5.3.4 Scan Policy

The Asiana B777 Pilot Operations Manual (POM), paragraph 2.13.5, "Scan Policy," dated March 27, 2008, addressed scan policy. It addresses the division of flight deck workload for instrument scan and acquisition of visual cues during landing. It stated for a visual approach below 1,000 ft. AGL²⁹ after visual contact was made with the airport both the PF and the PM should be scanning both inside and outside the airplane. It stated the PM should monitor airspeed and sink rate through the touchdown and when there was an additional pilot in the cockpit, he or she should perform back up duty for the PM during the approach.

²⁹ Above ground level

5.3.5 PF/PM Duties

The Asiana B777 POM, paragraph 2.13.1, “PF/PM’s Duties,” dated March 27, 2008, stated on all approaches the PF was responsible to:

- Maintain aircraft control and conduct the approach briefing
- Follow published approach procedures
- Cross check all flight instruments
- When using the AFDS, the PIC should be ready for manual flight before passing the final approach fix (FAF)

The PM on all approaches was responsible to:

- Make active standard callouts
- Cross check all primary instruments and raw data
- Monitor any display of warning/caution flags or deviation from the intended flight path and callout to the PF
- Monitor speed and descent rate until touchdown
- After landing, advise runway and taxiway to PF
- When aircraft is unstabilized or safe landing is not assured, advise the PF to make a missed approach.

5.3.6 Missed Approach (Go around) Procedure

The Asiana B777 Pilot Operations Manual (POM), paragraph 2.19.1.1, “Missed Approach (go around) Procedure – Decision and Control,” dated March 27, 2008, stated:

- The decision to make a missed approach rests with the captain. However, when the co-pilot (F/O) flies the aircraft as PF, the co-pilot (F/O) can make a missed approach.
- In the event of a go-around when the co-pilot flies the aircraft as PF, the co-pilot (F/O) must maintain positive control of the aircraft until the captain takes over the control saying “I HAVE CONTROL.”
- Refer to this chapter “stabilized approach” for the conditions of missed approach (go-around) in this POM.

5.3.6.1 Statements made about go around

The Asiana B777 Chief Pilot stated in an interview that all Asiana captains would agree that an FO could initiate a go around. Interviews with other Asiana pilots confirmed this statement. The Asiana Manager of Training stated if the pilot monitoring (PM) called for a go around twice and received no response, he could take control. An IP who conducted OE with the trainee captain was asked specifically if it was acceptable for a captain in the left seat who was being instructed to make the decision to go around. He said yes.

The trainee captain stated in an interview that only the IP had the authority to decide to go around.

5.3.7 Use of Speedbrakes

The Asiana B777 Pilot Operations Manual (POM), paragraph 2.12.9.7, “Use of Speedbrakes,” dated March 27, 2008, addressed speedbrake policy. It stated:

- “a. The PF should keep a hand on the speedbrake lever when the speedbrakes are used in-flight.*
- b. While using the speedbrakes in descent, allow sufficient altitude and airspeed margin to level off smoothly.*
- c. Lower the speedbrakes before thrust increase.*
- d. To avoid buffeting, use of speedbrakes with flaps greater than 5 should be avoided.*
- e. When condition is required to use speedbrakes with flaps extended, high sink rates during the approach should be avoided. Speedbrakes should be retracted before reaching 1,000 feet AGL.”*

5.3.8 Evacuation

The Asiana B777 Pilot Operations Manual (POM), “Emergency Landing and/or Evacuation,” paragraph 4.10.2.5, “After Landing or Rejected Takeoff,” dated March 27, 2008, addressed evacuation policy. It stated:

“Bring the aircraft to complete stop, set parking brake (if needed), and perform procedures as indicated below.

Note) If emergency evacuation is not necessary, the PIC or Co-pilot (F/O) should make a PA as soon as possible after the aircraft is completely stopped.

a. All possible cases to evacuate

Use the term “attention, crew at stations” to notify crew members.

b. Emergency evacuation is not needed

If emergency evacuation is not needed, use the term “Crew and passengers, remain seated.” to notify passengers and crew members.

CAUTION

1. Do the QRH memory items first.

2. After memory items are done, if passenger evacuation is required, conduct evacuation procedure by reading QRH.

3. When QRH is not available to use, conduct passenger evacuation check list by memory.

4. Make an evacuation on the runway as possible so that ground staff, equipment and vehicle can approach to airplane easily.

Note)

- 1. Evacuation must be made in a rapid and proper manner. The PIC may make announcement on the direction of exits depending on which engine has the fire, wind direction, attitude and position of the aircraft and the extent of aircraft damage, only when assured.*
- 2. If an engine fire or other conditions make certain exits unusable, state the direction of egress*

The Evacuation procedure was located on the back page of the Boeing B777 Quick Reference Handbook (QRH).³⁰

5.3.8.1 Statements made about the evacuation procedure

A simulator instructor stated if pilots missed a step on the evacuation checklist in training it would be a failure, and he did not think Asiana pilots would deviate from the evacuation checklist. He was asked if there was a step in the evacuation training that involved calling the tower before evacuating. He replied yes. He stated that it was not in the checklist but the pilot would want to confirm with the tower to see if they could see a fire outside. If an emergency had been declared, a fire truck might be able to confirm a fire. This situation would be if the crew was not sure about the condition of the airplane. If they were sure, they would have to immediately evacuate. Basically, they wanted to confirm that there was actually a fire before they evacuated.

5.4 Flight Crew Training Manual

The Boeing B777 FCTM was used by Asiana to train pilots on the B777. According to the introduction to the manual, page 0.2.1, dated June 30, 2013, the manual provided information and recommendations on maneuvers and techniques. It noted procedures and restrictions published in the FCOM, QRH and other documents took precedence over the FCTM. Figures in the manual were for training purposes only, and it was the responsibility of the individual airline to determine applicability of the manual to its operation.

5.4.1 AFDS Guidelines

The FCTM, page 1.33-34, dated June 30, 2013, stated;

“The Normal Procedures Introduction in Volume 1 of the FCOM states that normal procedures are written for the trained flight crew and assume full use of all automated features. This statement is not intended to prevent pilots from flying the airplane manually. Manual flight is encouraged to maintain pilot proficiency, but only when conditions and workload for both the pilot flying and pilot monitoring are such that safe operations are maintained. Many operators have developed an automation use policy that gives pilots the opportunity to maintain proficiency in manual flight.”

³⁰ See attachment 14 – QRH evacuation procedure.

The FCTM, page A.2.3, dated June 30, 2013, stated:

“Operators are encouraged to develop an automation use policy that gives pilots the opportunity to maintain proficiency in manual flight. The policy should encourage the crew to fly the airplane manually, as long as conditions and workload for both the pilot flying and pilot monitoring are such that safe operations are maintained.”

5.4.2 Autothrottle Use

The FCTM, page 1.34, dated June 30, 2013, stated:

“Autothrottle use is recommended during all phases of flight. When in manual flight, autothrottle use is also recommended, however manual thrust control may be used to maintain pilot proficiency.”

5.4.3 Automatic Flight

The FCTM, page 1.35, dated June 30, 2013, stated:

- *“Varied levels of automation are available. The pilot decides what level of automation to use to achieve these goals by selecting the level that provides the best increase in safety and reduced workload.”*
- *“Deviations from expected performance are normally due to an incomplete understanding of their operations by the flight crew. When the automatic systems do not perform as expected, the pilot should reduce the level of automation until proper control of path and performance is achieved.”*
- *“Reducing the level of automation as far as manual flight may be necessary to ensure proper control of the airplane is maintained.”*

The FCTM, page 5.26, dated June 30, 2013, stated “the use of FLCH is not recommended after the FAF (final approach fix).

5.4.4 Stall Protection Demonstration

The FCTM, page 7.11, “Stall Protection Demonstration,” dated June 30, 2013, described a demonstration to be used in B777 training to familiarize the pilot with stall warning and the correct recovery technique for conditions approaching the stall, with and without the autopilot. In a series of 3 approaches to stall from level flight, the first maneuver demonstrated the autothrottle “wake up” feature, the second demonstrated nose up trim inhibit below minimum maneuver speed and increased column force at less than minimum maneuver speed, and the third

demonstrated autopilot commanded descent at slightly above minimum maneuver speed when autothrottles are disarmed.³¹

6.0 Regulatory oversight

Regulatory oversight of Asiana in the Republic of Korea was the responsibility of the Korean Office of Civil Aviation (KOCA), a division of the Republic of Korea Ministry of Land, Infrastructure and Transportation (MOLIT). Laws, decrees and regulations governing Aviation in Korea include the Aviation Act, dated March 28, 2008, the Presidential Decree of Aviation Act, dated May 6, 2008, Ministerial Regulations of the Aviation Act, dated May 8, 2008, and the Flight Safety Regulations of Korea. Regulatory oversight of Asiana in the United States was the responsibility of the FAA.

6.1 Korean Office of Civil Aviation (KOCA)

Regulatory oversight of Asiana was conducted by the Air Operations Safety Division within the Flight Standards Division of the Office of Civil Aviation.³² The principal operations inspector (POI) assigned to Asiana, who worked in the Operations Safety Division, stated he oversaw everything in the Air Operations Certificate for Asiana.

The POI stated in an interview he had been assigned as POI to Asiana for 6 months and had been with the KOCA for 2.5 years. He stated he had one assistant POI and there were two principal maintenance inspectors (PMI's) assigned to Asiana as well. He stated he was also responsible for oversight of two other air carriers, Air Busan, which had 9 aircraft, and T-Way Airlines, which had 5 aircraft. He stated he was responsible for approving the entire Asiana training manual, including all changes, and FOM special limitations.

The POI stated the KOCA (MOLIT) only conducted pilot check rides of upgrading captains, and he did about 10 flight examinations per year, but he did not conduct the type rating check rides.

6.1.1 Korean Operations Specifications

KOCA issued operations specifications (ops specs) to Asiana. They were divided into part A – general, part B – enroute authorizations, limitations and procedure, and part C – airplane terminal instrument procedures and airport authorizations and limitations. Part E pertained to Mass and Balance. Ops Spec A067 pertained to special airports, and listed San Francisco as one of those airports authorized.

6.2 Federal Aviation Administration

³¹ See attachment 12 – Stall protection demonstration.

³² See attachment 8 – KOCA organization chart

Operations of foreign air carriers were regulated by the FAA under 14 CFR Part 129. In order to operate in the U.S., foreign carriers must obtain a permit issued by the U.S. Department of Transportation and obtain operations specifications issued by the FAA.³³ A list of foreign operators certified under Part 129 obtained from the FAA in July, 2013 showed 482 air carriers on the list.

According to information provided by the FAA, 14 CFR Part 129 specified that the carrier must meet the safety standards contained in Part 1 (International Commercial Air Transport) of Annex 6 (Operations of Aircraft) to the Convention on International Civil Aviation (Chicago Convention). Upon DOT notification of a pending foreign air carrier application, if the FAA has not made a positive assessment of those countries safety oversight capabilities, the FAA Flight Standards Service will direct its appropriate international field office to schedule an FAA assessment visit to the CAA of the applicant's country. Once the assessments visits have been completed, the FAA assessment team will return to the United States to compile the findings. If a CAA is found to be meeting its minimum safety obligations under the Chicago Convention, the FAA will forward a positive recommendation to DOT. If there is a pending foreign carrier application, DOT will issue the requested economic authority and FAA will issue operations specifications to permit the carrier to begin operations to or from the United States.

6.2.1 International Aviation Assessments Program (IASA)

According to information provided by the FAA, the FAA began a program to assess foreign air carriers in 1991. Details of this program were available to the public on the FAA website, including the subject areas to be assessed.³⁴ The FAA classified foreign operators into category 1 and category 2. The Republic of Korea was a category 1 country.

6.2.1.1 IASA classification definition

The FAA provided the following explanation of its classifications:

“The FAA has established two ratings for the status of countries at the time of the assessment: does comply with ICAO standards, and does not comply with ICAO standards.

They are defined as follows:

- ***Category 1, Does Comply with ICAO Standards:*** *A country's civil aviation authority has been assessed by FAA inspectors and has been found to license and oversee air carriers in accordance with ICAO aviation safety standards.*
- ***Category 2, Does Not Comply with ICAO Standards:*** *The Federal Aviation Administration assessed this country's civil aviation authority (CAA) and determined that it does not provide safety oversight of its air carrier operators in accordance with the minimum safety oversight standards established by the International Civil Aviation Organization (ICAO).*

This rating is applied if one or more of the following deficiencies are identified:

1. *the country lacks laws or regulations necessary to support the certification and oversight of air carriers in accordance with minimum international standards;*

³³ See attachment 15 - 14 CFR Part 129.

³⁴ See attachment 16 – FAA IASA program.

2. *the CAA lacks the technical expertise, resources, and organization to license or oversee air carrier operations;*
3. *the CAA does not have adequately trained and qualified technical personnel;*
4. *the CAA does not provide adequate inspector guidance to ensure enforcement of, and compliance with, minimum international standards;*
AND
5. *the CAA has insufficient documentation and records of certification and inadequate continuing oversight and surveillance of air carrier operations.*

This category consists of two groups of countries.

- *One group is countries that have air carriers with existing operations to the United States at the time of the assessment. While in Category 2 status, carriers from these countries will be permitted to continue operations at current levels under heightened FAA surveillance. Expansion or changes in services to the United States by such carriers are not permitted while in category 2, although new services will be permitted if operated using aircraft wet-leased from a duly authorized and properly supervised U.S. carrier or a foreign air carrier from a category 1 country that is authorized to serve the United States using its own aircraft.*
- *The second group is countries that do not have air carriers with existing operations to the United States at the time of the assessment. Carriers from these countries will not be permitted to commence service to the United States while in Category 2 status, although they may conduct services if operated using aircraft wet-leased from a duly authorized and properly supervised U.S. carrier or a foreign air carrier from a Category 1 country that is authorized to serve the United States with its own aircraft.*

No other difference is made between these two groups of countries while in a category 2 status.”

6.2.2 FAA oversight activities of Asiana Airlines

A POI was assigned by the FAA to provide oversight activities of Asiana Airlines in the U.S. In an interview the POI stated he had been with the FAA since 1981 and in his current position since January 2010. He stated there were three FAA inspectors assigned to oversight of Asiana: a POI, a PMI (principal maintenance inspector), and a PAI (principal avionics inspector). He was POI for 14 foreign (Part 129) air carriers including Asiana. In addition to the three inspectors assigned to Asiana, the FAA had geographic inspectors in various locations. The POI stated at each of the airports that were listed in Asiana’s operations specifications (ops specs) as regular airports, 3 FAA inspectors (POI, PMI, and PAI) based at those airports would be responsible for the ramp inspections to be done at that airport.

The POI stated the only type of inspection the FAA was authorized to do on Asiana was ramp inspections. Speaking on behalf of his own inspections, he could not recall any irregularities on Asiana airplanes. The records were in PTRS³⁵ and Asiana received a regular review each year, usually in the month of November. A review of 140 PTRS entries concerning Asiana since October 2011 showed that most entries were related to ramp inspections or ops specs revisions. 118 ramp inspections were conducted at 11 U.S. airports served by Asiana. One possible flight violation was noted, which was referred to Asiana Airlines and resolved by them. The POI stated when there was a possible regulatory violation by a foreign carrier, the FAA local office was

³⁵ Program tracking and reporting subsystem

responsible for conducting an investigation and handling enforcement. His office stood ready to assist the local offices, and he could track those investigations.

The POI explained that the focus of his activities as a part 129 POI was to maintain each carrier's ops specs, to approve various paragraphs of the ops specs which allowed the carrier to conduct operations in the U.S., to review the performance of each carrier and to generate recommendations for the work program. The ops specs contained all the operating authority given to the carrier for operations in the U.S. He felt his workload was adequate, and the other carriers he had assigned to him were similar in size to Asiana.

The POI stated the FAA was not authorized to ride a foreign carrier jumpseat or to conduct cockpit or cabin enroute inspections. He stated the FAA did not approve ops manuals or crew training programs, they had no oversight of these items, and it was the foreign CAA that approved them.

6.2.3 FAA Operations Specifications

The FAA issued op specs to Asiana Airlines which governed their operations in the U.S. They were divided into part A – general, part B – enroute authorizations, limitations and procedure, and part C – airplane terminal instrument procedures and airport authorizations and limitations. Ops Spec C077 pertained to terminal visual flight rules, limitations and provisions.

6.3 Additional Information

On January 4, 2013, The FAA issued Safety Alert for Operators (SAFO) 13002, “Manual Flight Operations.”³⁶ It stated:

“a recent analysis of flight operations data (including normal flight operations, incidents, and accidents) identified an increase in manual handling errors. The Federal Aviation Administration (FAA) believes maintaining and improving the knowledge and skills for manual flight operations is necessary for safe flight operations.

Operational policies should be developed or reviewed to ensure there are appropriate opportunities for pilots to exercise manual flying skills, such as in non-RVSM airspace and during low workload conditions. In addition, policies should be developed or reviewed to ensure that pilots understand when to use the automated systems, such as during high workload conditions or airspace procedures that require use of autopilot for precise operations.”

F. LIST OF ATTACHMENTS

Attachment 1: Interview summaries

³⁶ See attachment 17 – SAFO 13002.

Attachment 2:	Republic of Korea crew certification
Attachment 3:	Statements of Captains Kim and Jung
Attachment 4:	Asiana flight operations organization
Attachment 5:	Crew information summary
Attachment 6:	SFO arrival, approach and airport charts
Attachment 7:	B777 mode control panel and displays
Attachment 8:	KOCA organization chart
Attachment 9:	Asiana SFO special airport training slides
Attachment 10:	Asiana Landing Statistical Data
Attachment 11:	Simulator Photo of FMA in HOLD
Attachment 12:	Stall Protection Demonstration
Attachment 13:	Training Slides on Stall Protection and Autothrottle Modes
Attachment 14:	QRH Evacuation Procedure
Attachment 15:	14 CFR Part 129 Excerpts
Attachment 16:	FAA IASA Program
Attachment 17:	SAFO 13002
Attachment 18:	Trainee Captain's OE Training Record
Attachment 19:	Trainee Captain's Simulator Training Record
Attachment 20:	Instructor Pilot's Training Record